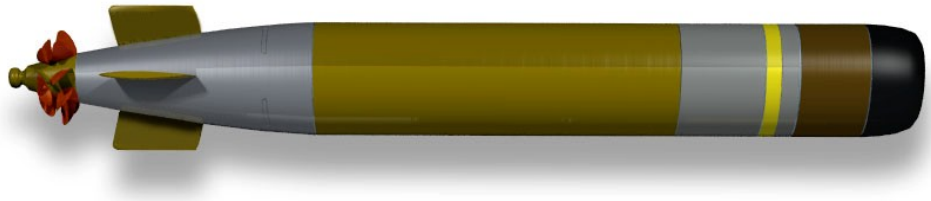
Undersea Warfare Center Division

Navy Technical Interchange Meeting:

Simulation and the Developmental and [illegible] Test of Undersea Weapons

Weapons Analysis Facility… A Synthetic Environment for Undersea Warfare Systems



Stephen J. Swenson
Head, WAF and

Overview

- **the Context**
- **Weapons Analysis Facility (WAF)**
- **Building / Maintaining Confidence**
- **Concluding Thoughts and Observations on Simulation, DT and OT**

Overview

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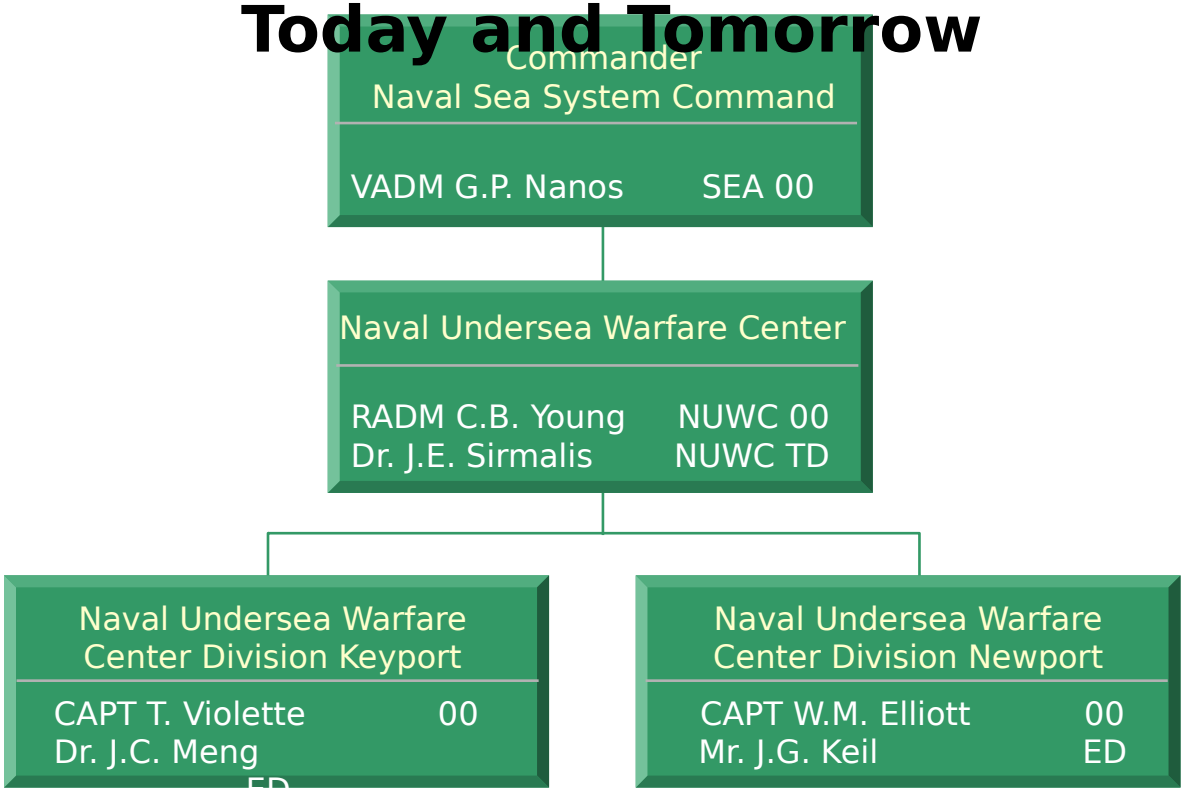
NUWC: Part of the NAVSEA Team

Mission: **Undersea Superiority Today and Tomorrow**


Commander
Naval Sea System Command
VADM G.P. Nanos SEA 00
Naval Undersea Warfare Center
RADM C.B. Young NUWC 00
Dr. J.E. Sirmalis NUWC TD
Naval Undersea Warfare Center Division Keyport
CAPT T. Violette 00
Dr. J.C. Meng
Naval Undersea Warfare Center Division Newport
CAPT W.M. Elliott 00
Mr. J.G. Keil ED

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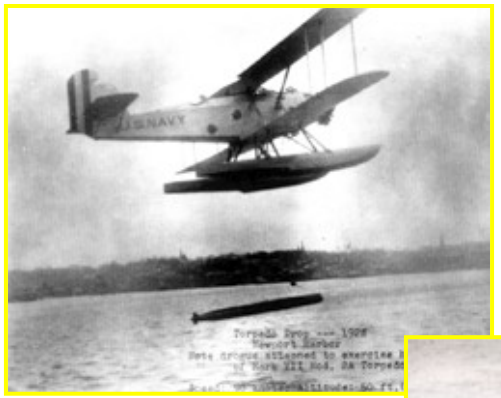
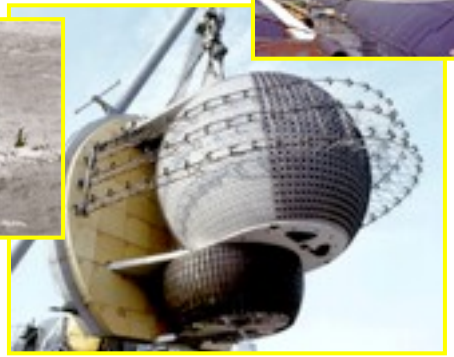
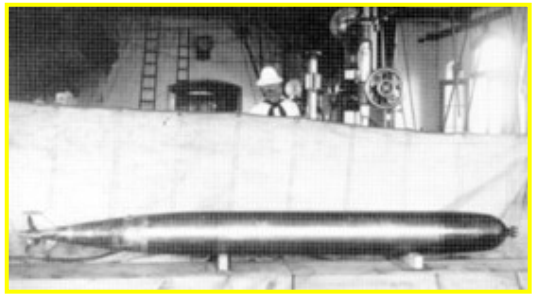
Corporate Knowledge







TORPEDOES	SONAR	COMBAT SYSTEMS	TOTAL SYSTEMS CAPABILITY
1860's	1940's	1960's	1992

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Contribution:

Products:

- USW Combat Systems
- Sonar
- Torpedoes, UUVs, Targets, & Countermeasures
- Launchers
- Electronic Warfare
- Ranges
- Communications
- Periscopes

Services:

- Warfare Analysis
- Research
- Modeling, Simulation, and Analysis
- Technical Design Authority
- Total Systems Engineering
- Installation
- In-Service Engineering
- Systems Maintenance
- Tech Assistance

Heavyweight Torpedoes
Inventory & Programs

Heavyweight Torpedo	Inventory Plans & Programs
	•SSBN Deployment Support •Foreign Military Sales •Bunker / Deep Stowage
MK 48 Mod 4	
	•Primary Sub-launch ASW & ASUW Torpedo (IOC 88) •ADCAP Block Upgrade Program •Improvements via software delivery •IOC Block I: 1991; II: 1994; III: 1997 •ADCAP Torpedo Improvement Program (ATIP) •Improve reliability Via Hardware Ordalt •Heavyweight Test Equipment Upgrade • Combine 48 & ADCAP Equipment (1998) •Foreign Military Sales
MK 48 ADCAP (Mod 5)	
	•ADCAP Ordalt Kit: IOC 1997 •G&C: Improved Processors •Torpedo Propulsion Upgrade •Reduce Radiated Noise
ADCAP Modifications (Mod 6)	

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Heavyweight Torpedoes
Inventory & Programs

Description / Summary

ADCAP Modifications
COTS Insertion
Commonality
Initiative

(COT-DV Program)

- **Torpedo Commonality & COTS Insertion**
  - **Incorporate Lightweight Hybrid Torpedo Common Torpedo Processor Into Mods**
- **Future ADCAP Full COTS Processor Use**
  - **Drop in card processor upgrade**
- **Software & Algorithm Commonality**
  - **Common "Core Software" & Unique merged to deliver op software version for lightweight and/or heavyweight torpedo**

CBASS Program

- **Common Broadband Advanced Sonar System**
- **Wideband Sonar for ADCAP Torpedo**
- **Shallow Water & CCM Improvements**
- **Features Support Close Encounter Capability**

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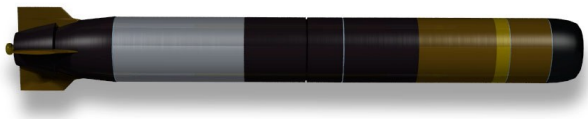
Lightweight Torpedoes
Inventory & Programs

Lightweight Torpedo

MK 46

MK 50



MK 54

Lightweight Hybrid Torpedo

Inventory Plans & Programs

- Air & Surface Launch
- Large Fleet & World Inventory
- Service Life Extension Program
  - Extend Life
  - Improved Shallow Water

- Advanced Lightweight Torpedo
  - Limited Inventory
  - Software Block Upgrade Program Completed
    - Block I IOC: 96 ; II On Shelf (to LHT)

- New Development
  - COTS Based Common Torpedo Processor
  - Maximum Use of Available Government Furnished Hardware
    - MK 50 Sonar ... MK 46 Propulsion & Warhead
  - Low Development & Life Cycle Cost

Overview

- the Context
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Impact on Warfighter

The most important way technology could enhance our military capability would be to cut the acquisition cycle in half.

Chairman of the Joint Chiefs of Staff - Packard Commission 1986

Phase 0	Concept Exploration	0-2 y
Phase I	Demonstration Validation	2-4 years
Phase II	Engineering Manufacturing Dev	4-7 y
Phase III	Production and Deployment	
Phase IV	Support	10-50 years
	Development Range	6-13
	Deployment Range	8-21

Defense Systems Management College Wall Chart A/O1997

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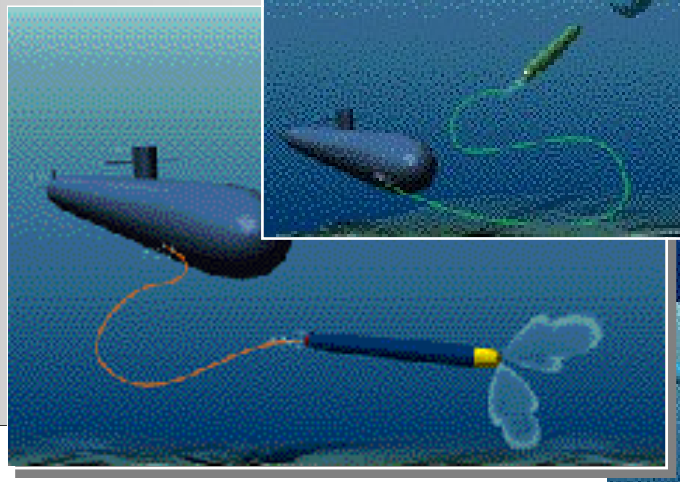
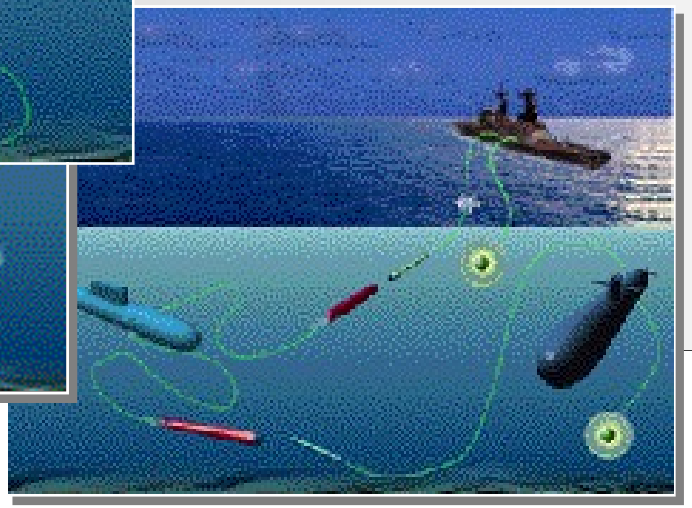
Weapons Analysis Facility

Heavyweight and Lightweight Torpedoes



Unmanned Undersea Vehicles

- Actual vehicle hardware and operational software
- Leading edge environmental and threat models
- Comprehensive analysis tool suite
- User friendly interface

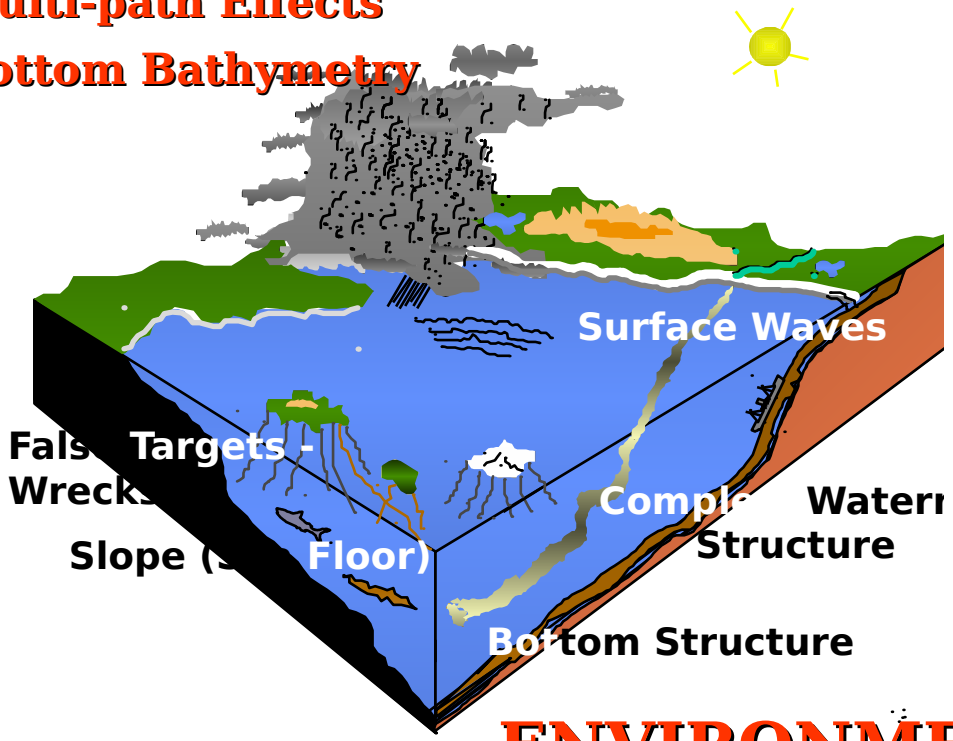


Countermeasures and Undersea Defensive Weapons

WAF: U.S. Navy's Most Advanced Real-Time Hardware-In-The-Loop Underwater Vehicles

Weapons Analysis Facility

- **Complex Sound Speed Profiles**
- **Ambient Noise**
- **Volume & Boundary Reverberation**
- **Multi-path Effects**
- **Bottom Bathymetry**



ENVIRONMENT

THREAT

- **Aspect Dependence**
- **Active Response**
- **Radiated Noise**
- **Hydro-dynamics**

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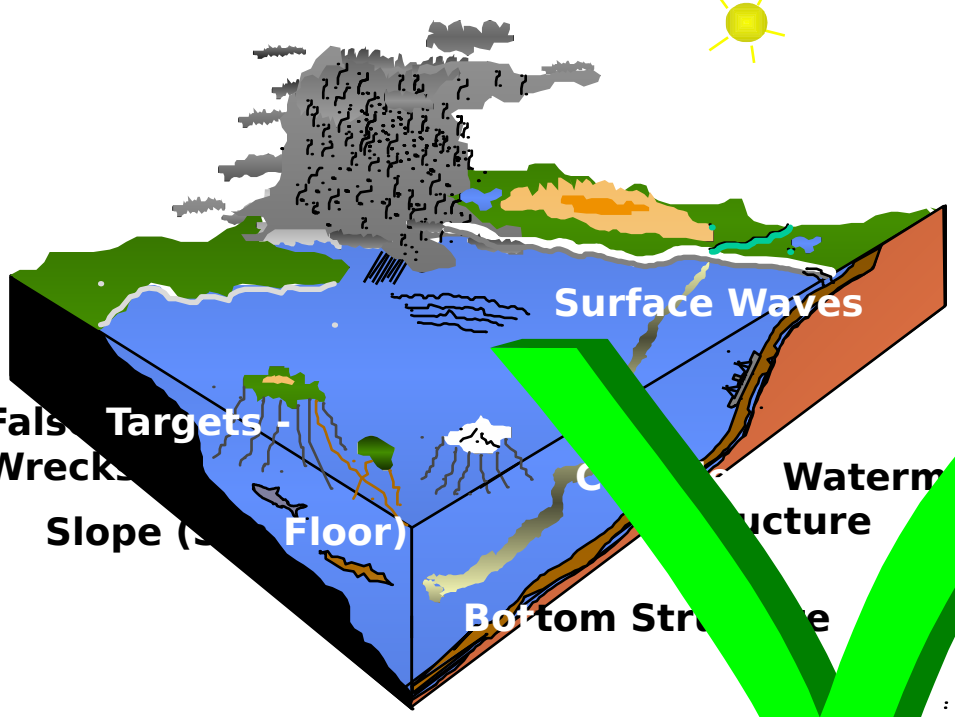
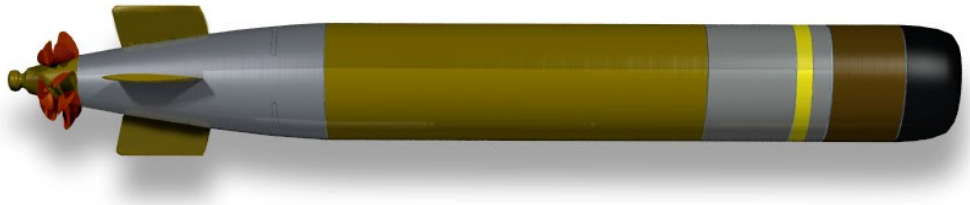
Weapons Analysis Facility



ENVIRONME
NT



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Weapons Analysis Facility

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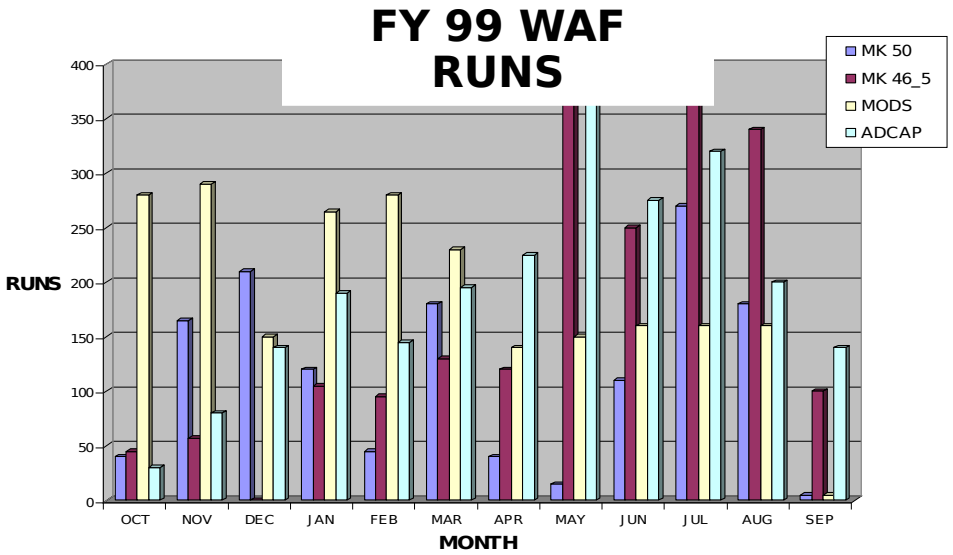
Cost Effective Approach to Weapons T&E



- Actual System, Hardware and Software in an High Fidelity Synthetic Environment
- Ability to Replicate Events Witnessed In-water and Initiate Software Improvements
- Control over Scenario-Dependent Factors to Facilitate Evaluation of System Changes
- A Cost of Less than 1% of In-water Tests

NEARLY 50,000 WAF RUNS SINCE

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Broad Applicability

- Transition Readiness
- Integrated Systems Testing
- Software Development
- System / Concept Development & Selection
- Data Base Expansion
- Performance Assessment
- Performance Limit Testing
- Tactics Development
- Training
- System Diagnostics
- Exploitation
- Vulnerability Studies
- Operational Test
- In-Water Run Previews

Benefits

- Operationally Significant Environments
- Controlled Repeatable Test Conditions
- Cost Avoidance Through Reduction of In-Water Runs
- Early Introduction of Advanced Concepts
- Early Introduction of the Warfighter

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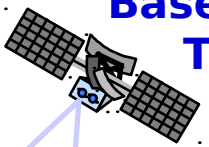
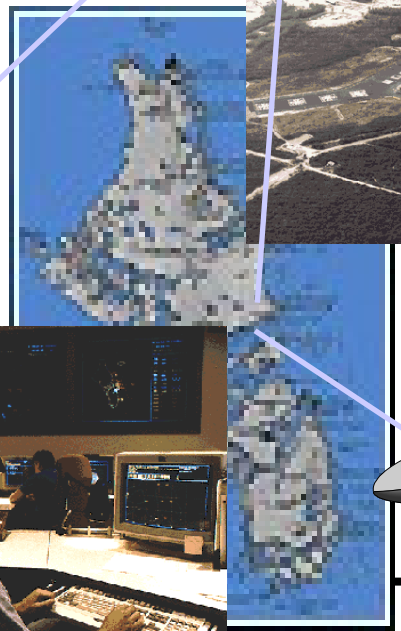
Synthetic Environment Tactical Integration (SETI)

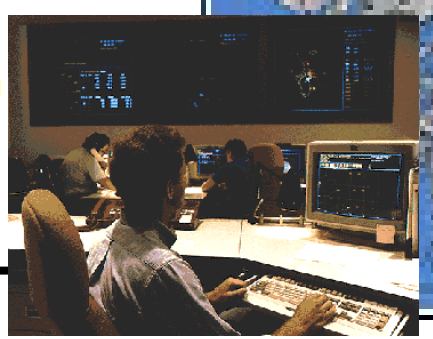
Weapons Analysis Facility

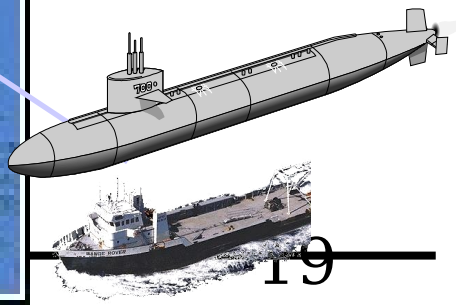
Exercise Communications Cen

Expandable to Other Training Ranges, Shore Based Trainers, and T&E Facilities









AUTEC

Overview

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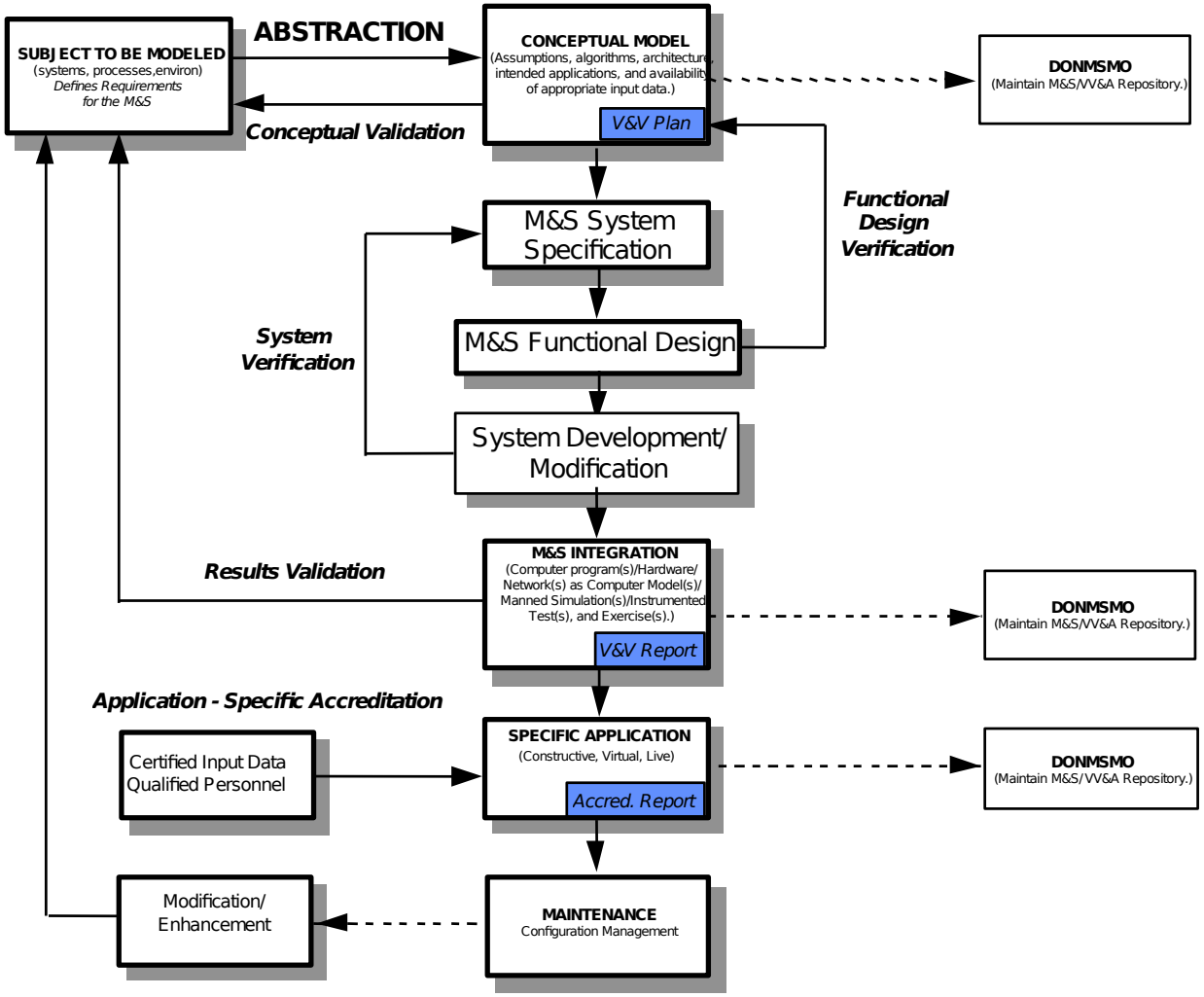
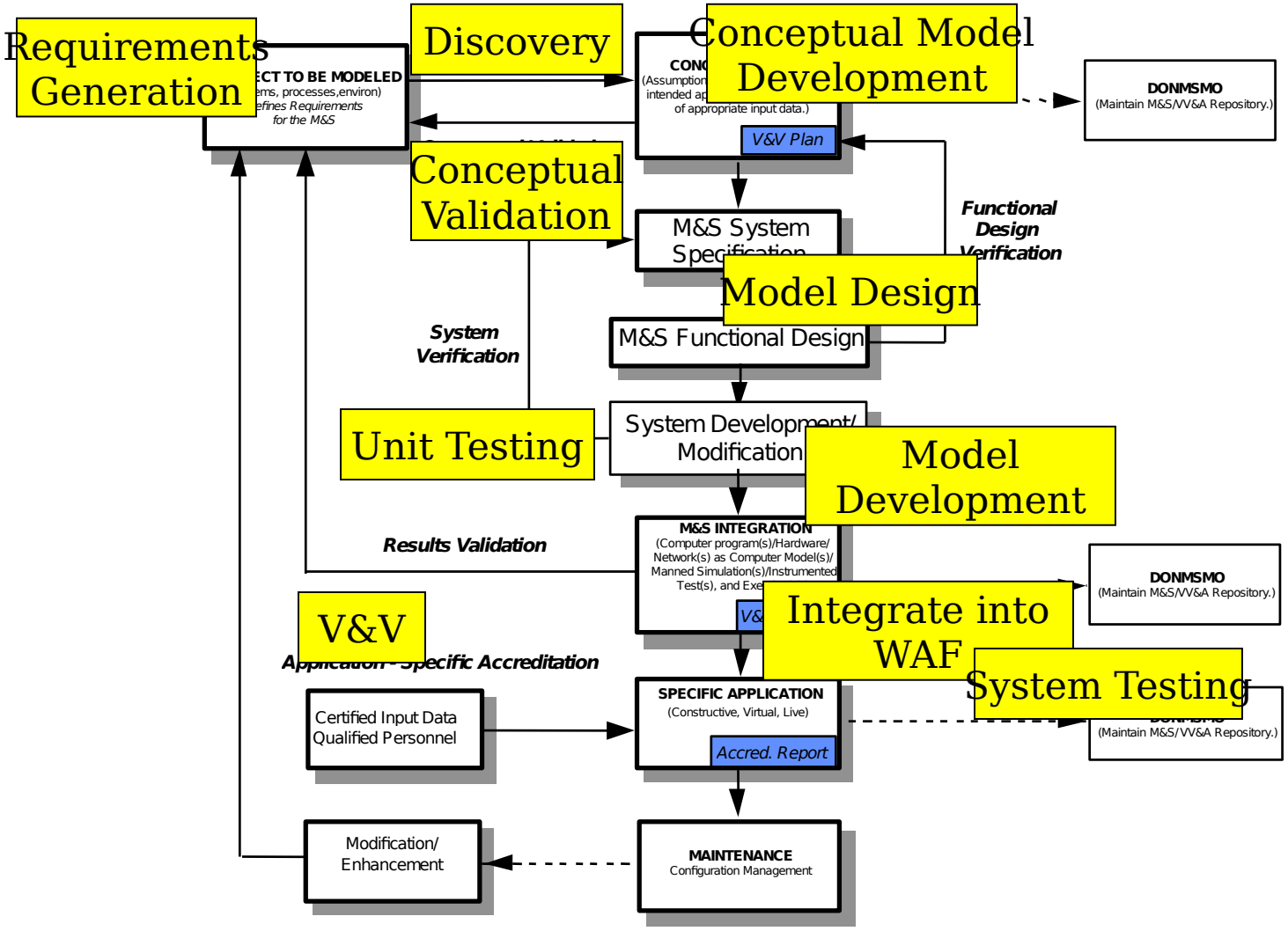
SECNAVINST 5200.40



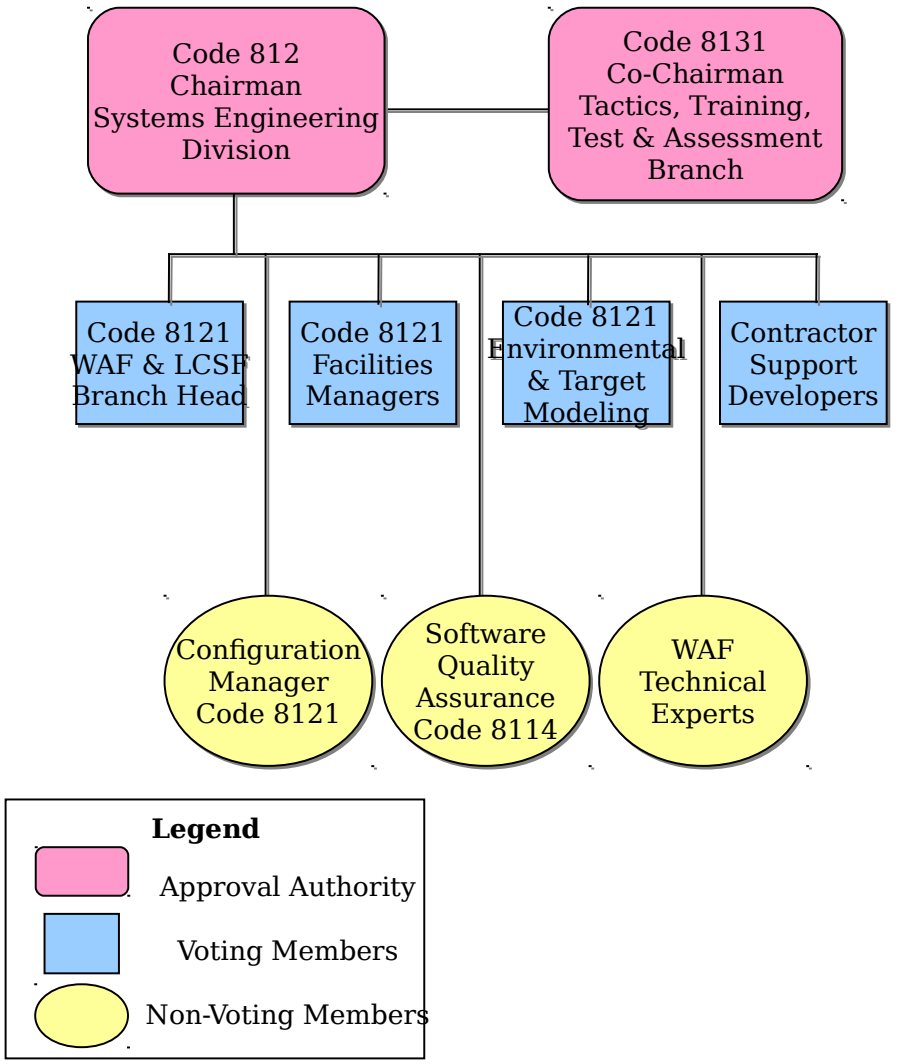
SECNAVINST 5200.40



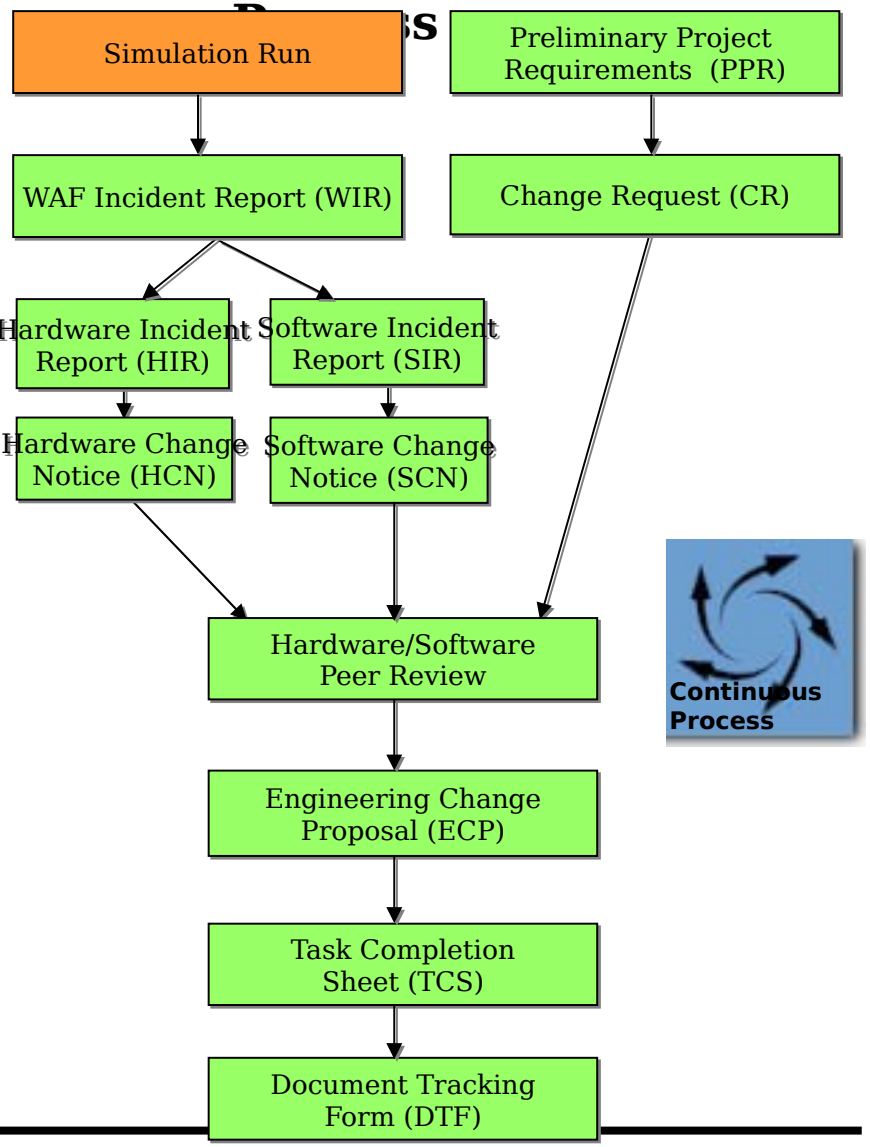
WAF CONFIGURATION MANAGEMENT

Undersea Warfare Center Division

WAF CCB

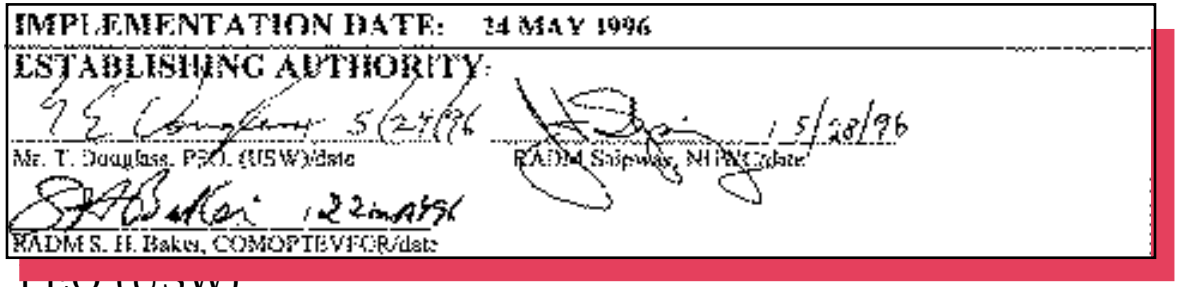


WAF CM Process



WAF Integrated Process Team

- Mission Statement:
  - Optimize WAF as a National USW Modeling and Simulation Asset
  - Pursue and Achieve Process and Product Improvements
  - Provide a Bridge Between Management, WAF Personnel, and Customers


IMPLEMENTATION DATE: 24 MAY 1996

ESTABLISHING AUTHORITY:

5/24/96

Mr. T. Douglass, PEO (USW)/date

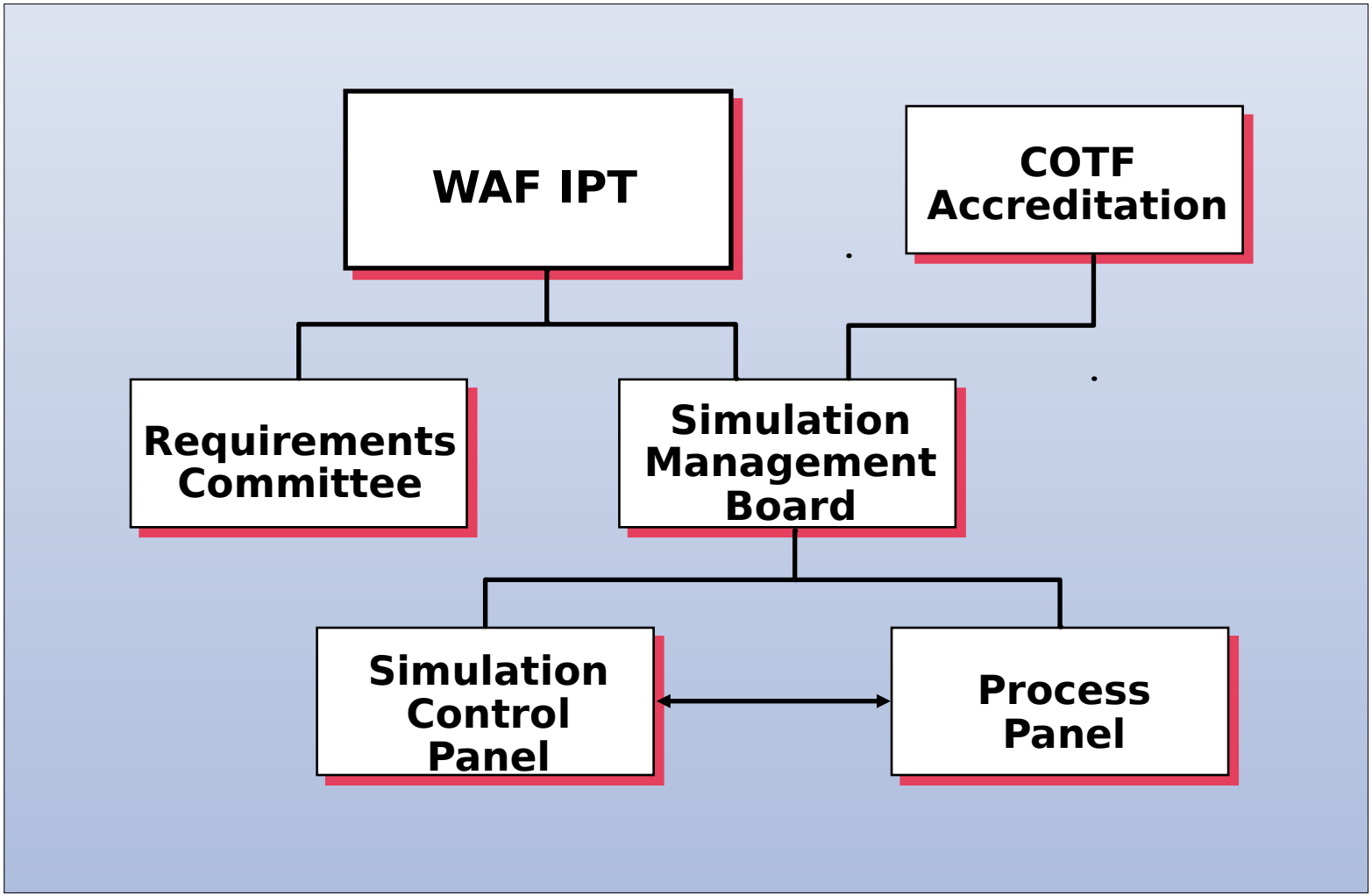
5/28/96

RADM Shipway, NHPA/date

RADM S. H. Baker, COMOPTEVFOR/date

- Chair: PEO (USW)
- Members:
  - PMS 404/415/427
  - ONI
  - ONR
  - COMOPTEVFOR
  - NUWC
  - N86/87/91
  - DOT&E
  - NAVSEA 91T
  - NAVMSMO/N6M

WAF IPT Structure



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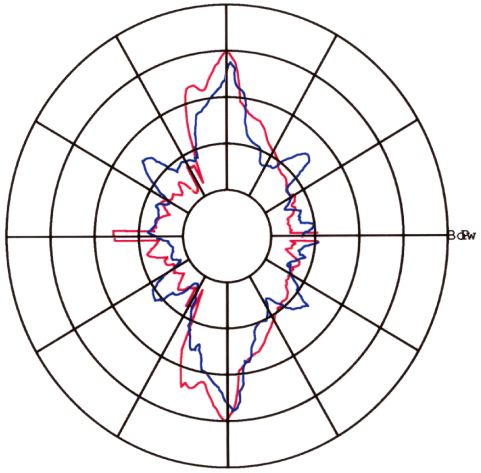
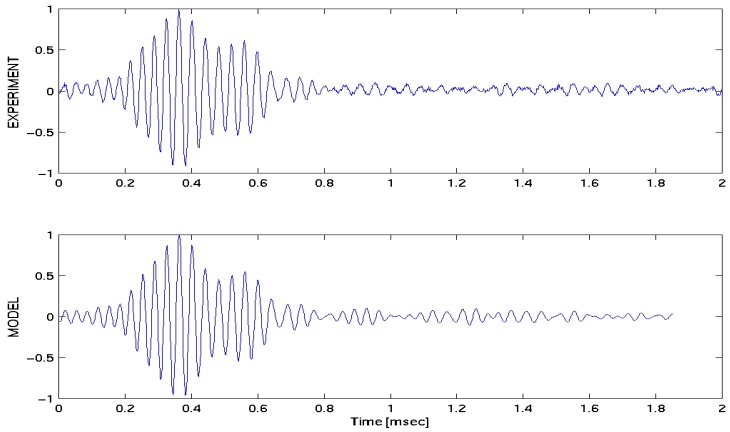
Confidence

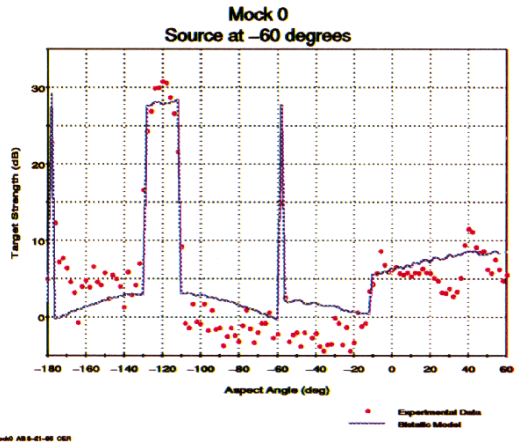
Peak Target Strength Plot

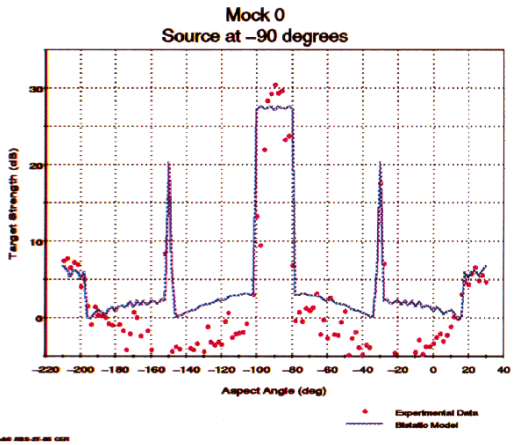


Echo Level for Broadband Pulse



Bistatic Target Strength of a Scale Model





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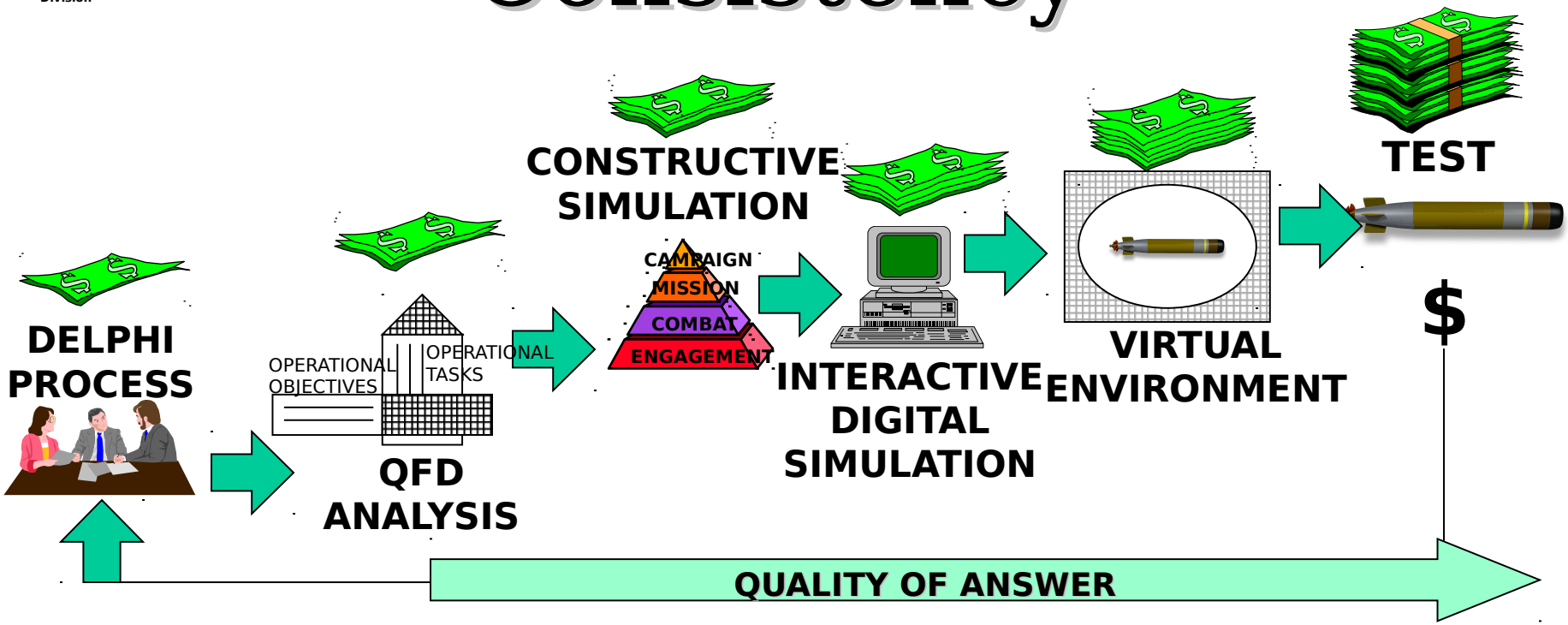
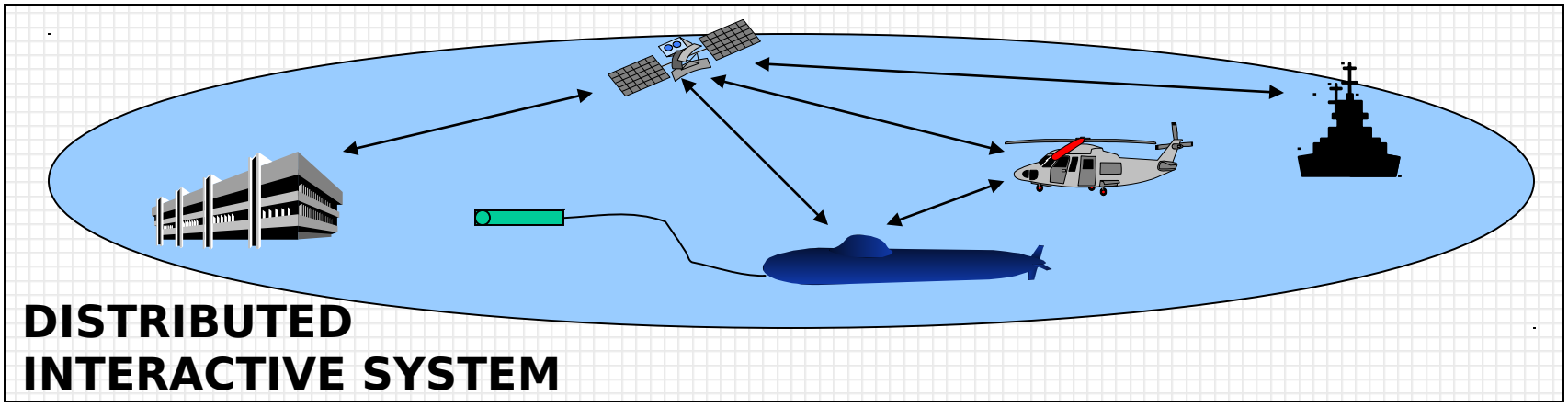
Consistency





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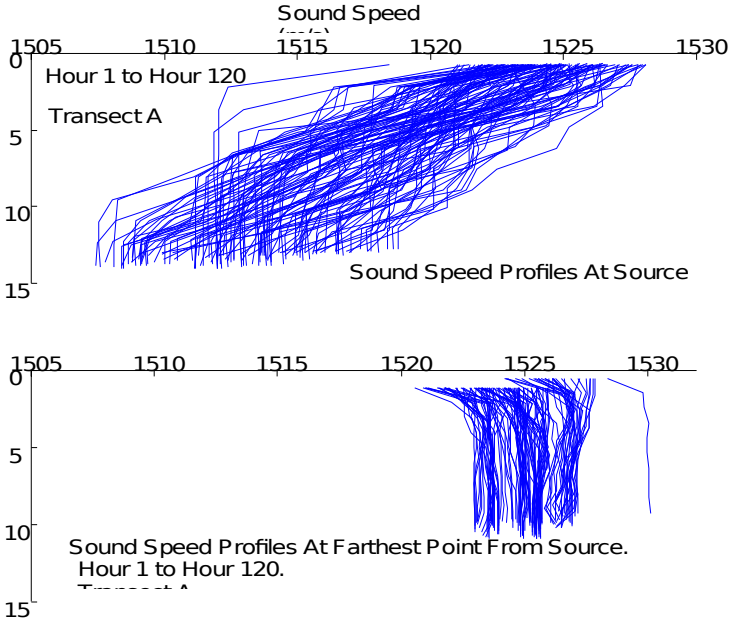
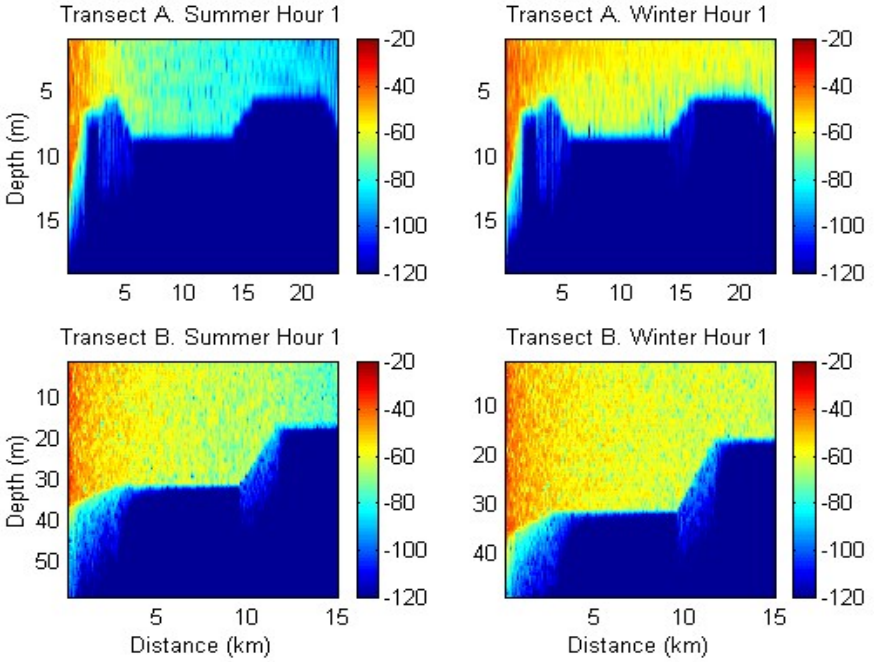
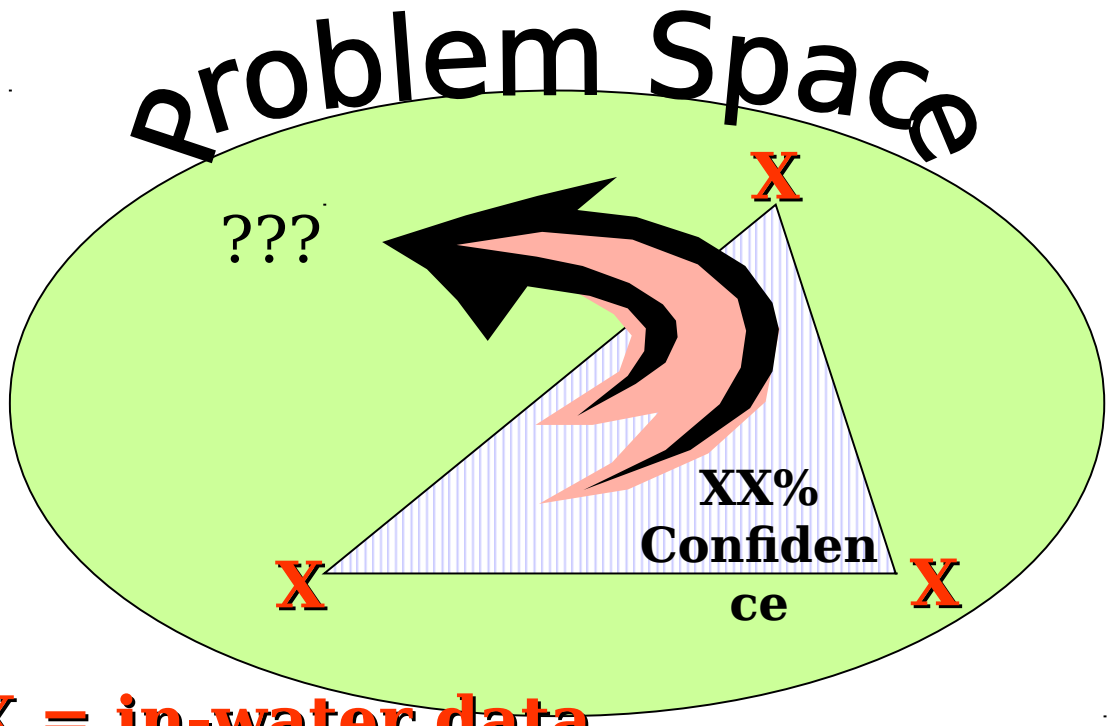
Don’t Forget About the Data

- Quality
- Availability
- Variability
- Graceful Degradation in Absence of Data





…Getting to Extrapolation



X = in-water data point